PATENT

S/N 10/039,047

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Lee Friedman	Examiner:	Sean M. Reilly
Serial No.:	10/039,047	Group Art Unit:	2153
Filed:	December 31, 2001	Docket No.:	60027.0218USU1
Title:	MULTIMEDIA DISTRIBUTION IN A HETEROGENEOUS NETWORK		

CERTIFICATE UNDER 37 CFR 1.6:
I hereby certify that this correspondence is being transmitted by facsimile to the U.S. Patent and Trademark Office on September 11, 2006.

Murrell W. Blackburn

Murrell W. Blackburn, Reg. No. 50,381

DECLARATION OF LEE FRIEDMAN UNDER 37 C.F.R. §1.131

Lee Friedman declares that:

1.

This declaration is to establish completion of the invention in this application in the United States on a date prior to June 12, 2001.

2.

I am the inventor of the invention described in U.S. Provisional Patent Application Serial No. 60/336,332 filed on November 2, 2001, entitled "MULTIMEDIA DISTRIBUTION IN A HETEROGENEOUS NETWORK."

3.

I was an employee of BellSouth Corporation, assignee for the above-identified patent application, at the time the invention described and claimed in this patent application was invented, and I am still employed by BellSouth Corporation.

4.

An exchange of draft provisional patent applications occurred over a period of several weeks. The provisional patent application was subsequently filed on November 2, 2001. Thus, the patent application process was begun by me prior to June 12, 2001 and completed by November 2, 2001. Exhibit X shows an initial email enclosing a first draft provisional patent application completed prior to June 12, 2001. I replied to this email with comments and received emails enclosing other draft patent applications prior to June 12, 2001. This subsequent email correspondence is also shown in Exhibit X along with a draft provisional patent application.

5.

The draft provisional patent application shown in Exhibit X was complete prior to June 12, 2001 and discloses embodiments of the invention drawn to distribution of multimedia content to multiple destinations on a heterogeneous network. For instance, page 4 of Exhibit X describes network segments that are subject to varying distribution parameters and that these parameters establish a "quality of service" of each network segment.

6.

Page 5 of Exhibit X discloses when network segment parameters change, that central servers reprogram dispersed media servers to adapt to accommodate the new network parameters.

7.

Still further, pages 10-12 of Exhibit X disclose a process flow of the media server including programming of media servers to adapt to multimedia content, receiving transmission of content data from source servers, and transmitting multimedia content to intended recipients based on parameters of intended network segments.

8.

Pages 10-12 of Exhibit X also disclose Figure 1 and a description of Figure 1 illustrating dispersed media server architecture with media servers programmed by central servers to adapt multimedia content according to parameters of each intended network segment downstream.

9.

After some delay in my review and comments on the initial draft provisional patent applications referred to above, a final draft provisional patent application was completed and forwarded to me for review subsequent to June 12, 2001. Exhibit Y includes correspondence disclosing some delay in my review of a draft patent application, correspondence with respect to a final provisional patent application draft, and the final draft provisional patent application completed subsequent to June 12, 2001.

10.

The final draft provisional patent application shown in Exhibit Y was complete prior to November 2, 2001 and discloses distribution of multimedia content to multiple destinations on a heterogeneous network. For instance, page 5 of Exhibit Y describes network segments that are subject to varying distribution parameters and that these parameters establish a "quality of service" of each network segment.

11.

Page 7 of Exhibit Y discloses when network segment parameters change, that central servers reprogram dispersed media servers to adapt to accommodate the new network parameters.

12.

Still further, pages 13-16 of Exhibit Y disclose a process flow of the media server including programming of media servers to adapt to multimedia content, receiving transmission of content data from source servers, and transmitting multimedia content to intended recipients based on parameters of intended network segments.

13.

Pages 13-16 of Exhibit Y also disclose Figure 1 and a description of Figure 1 illustrating dispersed media server architecture with media servers programmed by central servers to adapt multimedia content according to parameters of each intended network segment downstream.

14.

All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true, and further, these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patents issuing thereon.

Lee Friedman

9/11/06

Date

10615 Timberstone Rd Alpharetta, GA 30022

Residential Address

EXHIBIT X

Parks, Cynthia

From: Parks, Cynthia
Sent: [redacted]
To: Lee Friedman (E-mail)
Cc: Tocups, Nora
Subject: Draft of provisional application

Importance: High

Lee,
as I mentioned, the attached is a password-protected draft of the first sections of the provisional application for "Multimedia Distribution in a Heterogeneous Network." Please review it, and let's discuss its accuracy, and how I will add detail to the remainder of the document. We would like to file this with the Patent Office [redacted]

13XDOC01_.DOC

Thank you.

Cynthia Parks
Associate, Intellectual Property
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1100 Peachtree Street
Suite 2800
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404.815.6555 fax
CParks@KilpatrickStockton.com

Nora, our version of the file is ATLLIB01 1161080.1.

Tracking:

Recipient	Read
Lee Friedman (E-mail)	
Tocups, Nora	[redacted]

Parks, Cynthia

From: Parks, Cynthia
Sent: [redacted]
To: Lee Friedman (E-mail); 'lgf@bellsouth.net'
Cc: Tocups, Nora
Subject: Provisional application

Hi Lee
Here's another pass. Thanks!

13XDC01_.doc

Cynthia Parks
Associate, Intellectual Property
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Suite 2800
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404.815.6632
404.815.6555 fax
CParks@KilpatrickStockton.com

Parks, Cynthia

From: Parks, Cynthia
Sent: [redacted]
To: Lee Friedman (E-mail); Lee Friedman (E-mail 2)
Cc: Tocups, Nora
Subject: Provisional application

Importance: High

Lee
I've added some more detail. Please give me more feedback when you can. Thank you.

13xdc02_.DOC

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3

MULTIMEDIA DISTRIBUTION IN A HETEROGENEOUS NETWORK

The present inventions relate to applications or other implementations that distribute multimedia content from a single source to many users on a heterogeneous network. Advantageously, these inventions transmit multimedia content reliably and consistently regardless of the distribution parameters of various segments of the network (e.g., unicast, or multicast).

SUMMARY OF THE INVENTIONS

The inventions relate to systems and methods of distributing multimedia content over a heterogeneous network. The term "inventions" is used herein to encompass all aspects and forms of the inventions including methods, apparatus, systems, and mediums.

The present inventions optimize the distribution of multimedia content from a single source to multiple destinations along a heterogeneous network. A heterogeneous network includes segments that are subject to varying distribution parameters. These parameters include bandwidth restrictions, protocol restrictions, and routing restrictions. Such parameters establish the level of performance of each network segment, commonly referred to as the "quality of service" (QoS). One approach to distributing content over a heterogeneous network is to format and transmit multimedia content separately to each segment according to its QoS parameters. This approach is disadvantageous in that the bandwidth required is multiplied by the number of segments that have a different QoS. Another approach is

to minimize the number of transmissions by supporting a limited number of QoS levels, including a best-effort class. This approach is suggested in an article by Salgarelli *et al*, entitled "*Supporting IP Multicast Integrated Services in ATM Networks*" (Proceedings of SPIE Voice&Video '97, Broadband Networking Technologies). However, this approach also consumes additional bandwidth.

Because the multimedia content proliferates according to the distribution parameters of each network segment, an advantage of the present inventions is a minimization of the bandwidth that is consumed at the source upon transmission of the multimedia content.

DETAILED DESCRIPTION OF THE INVENTIONS

Overview

The systems and methods of the present inventions optimize the distribution of multimedia content based on the parameters of segments of the network at a given time. Further, if segment parameters change, then the central servers reprogram the dispersed media servers to adapt to accommodate the new network parameters.

In an exemplary embodiment, the present inventions comprise a network architecture that includes a central set of servers located at the source of the distribution of the multimedia content. The central servers are connected to a communications network that includes multiple segments, any of which may branch off from the backbone of the communications network. Media servers are dispersed throughout the network such that one media server is positioned at the head of each network segment. Each media server is programmed by the central servers to

distribute multimedia content according to the distribution parameters of its adjacent segment or segments.

Exemplary Environment

In an exemplary embodiment, the environment in which the present inventions may be implemented is a communications network. A communications network is a system that transmits any combination of voice, video and/or data between targeted stations. It includes the transmission media (e.g., cables) and all supporting hardware (e.g., bridges, routers and switches), and may include antennas and towers. The environment of the present inventions may be comprised of a combination or combinations of network types (e.g., peer-to-peer or client/server), scales (e.g., local area network (LAN) or wide area network (WAN)), and physical and logical network structures.

Centralized Source Servers

Referring to Fig. 1, the present inventions are implemented using a set of centralized servers positioned at the source of the distribution of media content, hereinafter referred to as "source servers." Each source server may be a computer or other device that manages network resources and processes requests for media content.

As illustrated in Fig. 2, an exemplary source server for implementing the inventions comprises a computer including a processing unit, a system memory, and a system bus that couples the system memory to the processing unit. The system memory includes read only memory (ROM) and random access memory (RAM). A basic input/output system (BIOS), containing the basic routines that help to transfer

information between elements within the computer, such as during start-up, is stored in ROM. The computer further includes a hard disk drive, a magnetic disk drive, e.g., to read from or write to a removable disk, and an optical disk drive, e.g., for reading a CD-ROM disk or to read from or write to other optical media. The hard disk drive, magnetic disk drive, and optical disk drive are connected to the system bus by a hard disk drive interface, a magnetic disk drive interface, and an optical drive interface, respectively. The drives and their associated computer-readable media provide nonvolatile storage for the computer. Although the description of computer-readable medium above refers to a hard disk, a removable magnetic disk and a CD-ROM disk, other types or media readable by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli, cartridges, and the like, may also be used.

A number of program modules may be stored in the drives and RAM, including an operating system, one or more application programs, a shared code library, and a property browser program module. A user may enter commands and information into the personal computer through a keyboard and pointing device, such as a mouse. Other input devices may include a microphone, joystick, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit through a serial port interface coupled to the system bus, but may be connected by other interfaces, such as a universal serial bus (USB). A monitor or other type of display device may also be connected to the system bus via an interface, such as a video adapter. In addition to the monitor, computers typically include other peripheral output devices (not shown), such as speakers or printers.

The source server operates in a networked environment using logical connections to one or more media servers. Media servers typically include many or all of the elements described in the source server. Each media server is connected to one or more recipient computers. The recipient computers may be personal computers (PCs), hand-held units, multiprocessors systems, microprocessor systems, minicomputers, mainframe computers, and the like. Each recipient computer may include a memory storage device, which may include stored program modules that are executable by the media server. The logical connections include a local area network (LAN) and a wide area network (WAN).

When used in a LAN networking environment, the recipient computer is connected to the LAN through a network interface. When used in a WAN networking environment, the recipient computer typically includes a modem or other means for establishing communications over the WAN, such as the Internet. The modem, which may be internal or external, is connected to the system bus via the serial port interface. In a networked environment, program modules depicted relative to the personal computer, or portions thereof, may be stored in the remote memory storage device. The network connections are exemplary and other means of establishing a communications link between the recipient computer and the network may be used.

In the exemplary embodiment of the present inventions, each source server includes a console or other user interface that enables an administrator to specify the parameters of each segment of the network. The segment parameter data stored in the

centralized source servers are used to program the appropriate dispersed media servers.

Network Segments

In the exemplary environment, the communications network includes multiple segments. Assume that each of the segments is subject to different parameters, such as bandwidth restrictions, communications protocols, and routing restrictions.

Bandwidth, commonly expressed in bits per second (bps), represents the transmission capacity of a communications network. Different network technologies are subject to varying bandwidth parameters. For example, the capacity of an unswitched private T1 segment is 1.6Mbps, while the capacity of an OC48 ATM segment can exceed 2488Mbps.

Assume that each network segment is governed by varying rules governing the transmitting and receiving of data, commonly referred to as protocols. Examples of protocols include Internet Control Message Protocol (ICMP), User Datagram Protocol (UDP), Transmission Control Protocol (TCP), and Internet Group Management Protocol (IGMP). Some communications networks have the capability of sending "one-to-many" transmissions of content to multiple intended recipients (multicast), while others can only "unicast", which requires an individual transmission for each intended recipient.

Assume further that each network segment is also subject to different routing parameters. Routers typically use mathematical formulae, known as routing protocols, to determine which of several available paths is the most expedient path along which to forward a stream of transmitted data packets to their final destination.

The routers may consider network characteristics such as traffic, speed, and economics to optimize the data path. Commonly, route servers process this information, which is then passed on to the routers, thereby allowing the routers to focus only on forwarding the stream of data packets accordingly. Routers also replicate transmissions as required depending upon whether the transmissions will be forwarded onto unicast or multicast segments.

In an exemplary embodiment of these inventions, to achieve distribution of multimedia content while maintaining a consistent quality of service (QoS), an architecture of centralized source servers coupled with dispersed media servers adapts the distributed media content to the varying parameters of the intended network segments.

Dispersed Media Server Architecture

As illustrated in Fig. 1, the exemplary embodiment includes media servers that are dispersed throughout the communications network, optimally being positioned at the head of each network segment. Assume that each media server has been programmed by a source server to adapt multimedia content according to the parameters of each intended segment that is downstream from the media server.

Assume that when a source server receives a request for multimedia content to be distributed, it transmits the content to all intended media servers. Each media server then transmits the multimedia content to intended recipients, according to the parameters of the intended segment or segments.

As an example, typically, a separate stream of data packets must be created, addressed, and forwarded for each destination on a unicast segment of the network.

Thus, at the source of the broadcast, copies must be made of the stream of data packets before transmission. If synchronized reception is intended, the source must transmit the copies of the stream of data packets simultaneously, thereby increasing bandwidth consumed several fold. In contrast, for each multicast network segment to which it is interconnected and to which transmission is intended, a router addresses and forwards a copy of the stream of data packets. Therefore, only one stream of data packets must be transmitted from the source to the network. When the stream of data packets reaches a router, the router forwards copies to multicast network segments as appropriate, and the original stream of data packets continues to the next router or destination. Disadvantageously, a source that intends synchronized reception by destinations located on both unicast and multicast segments of a heterogeneous network must simultaneously transmit the single stream of data packets for the multicast segments, and a copy for each unicast destination. In an exemplary embodiment, the media servers are programmed to receive a single transmission of a stream of data packets, and to forward the stream of data packets to the intended segments of the network according to parameters of each intended segment. When the transmission reaches routers positioned downstream from the media server, the routers perform replication of the multimedia stream where needed, and forward the multimedia stream to its intended recipients.

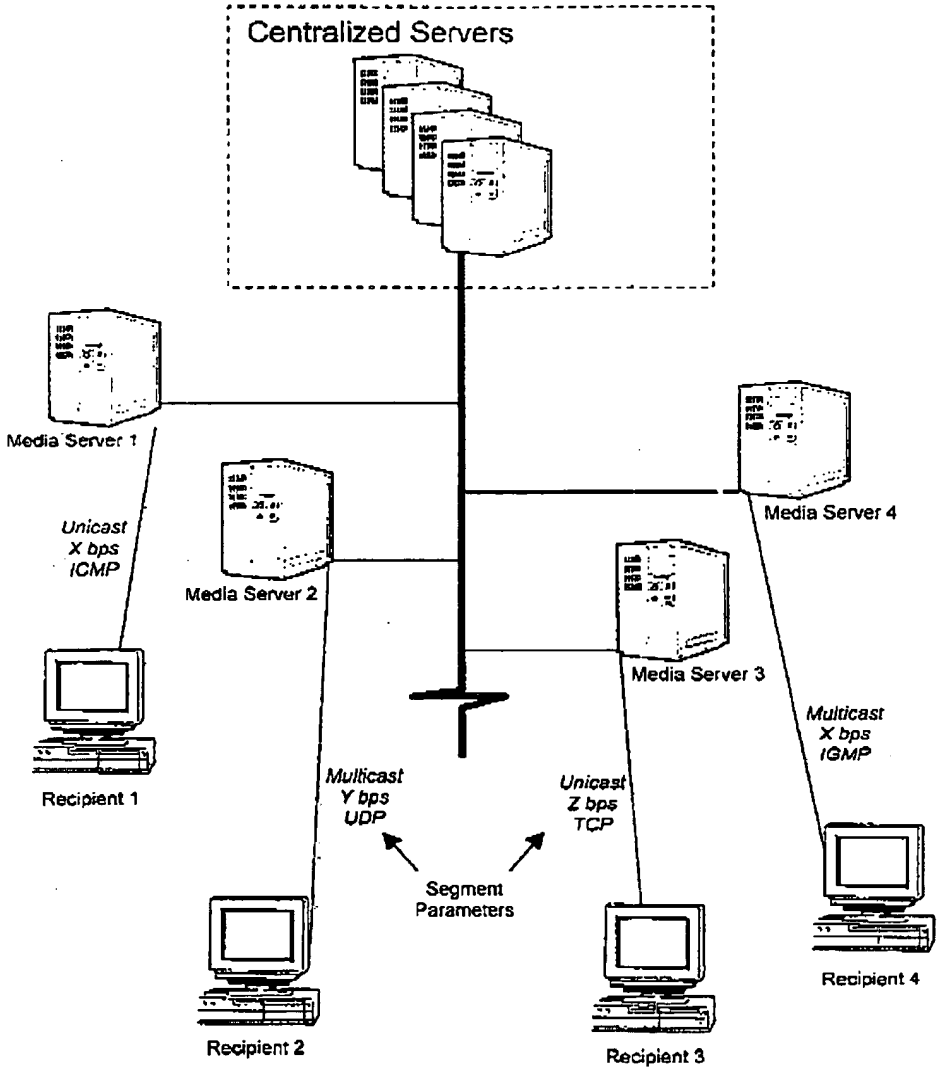
Centralized Servers
Media Server 1
Media Server 2
Media Server 3
Media Server 4
Unicast
X bps
ICMP
Recipient 1
Multicast
Y bps
UDP
Unicast
Z bps
TCP
Segment
Parameters
Multicast
X bps
IGMP
Recipient 2
Recipient 3
Recipient 4

Figure 1

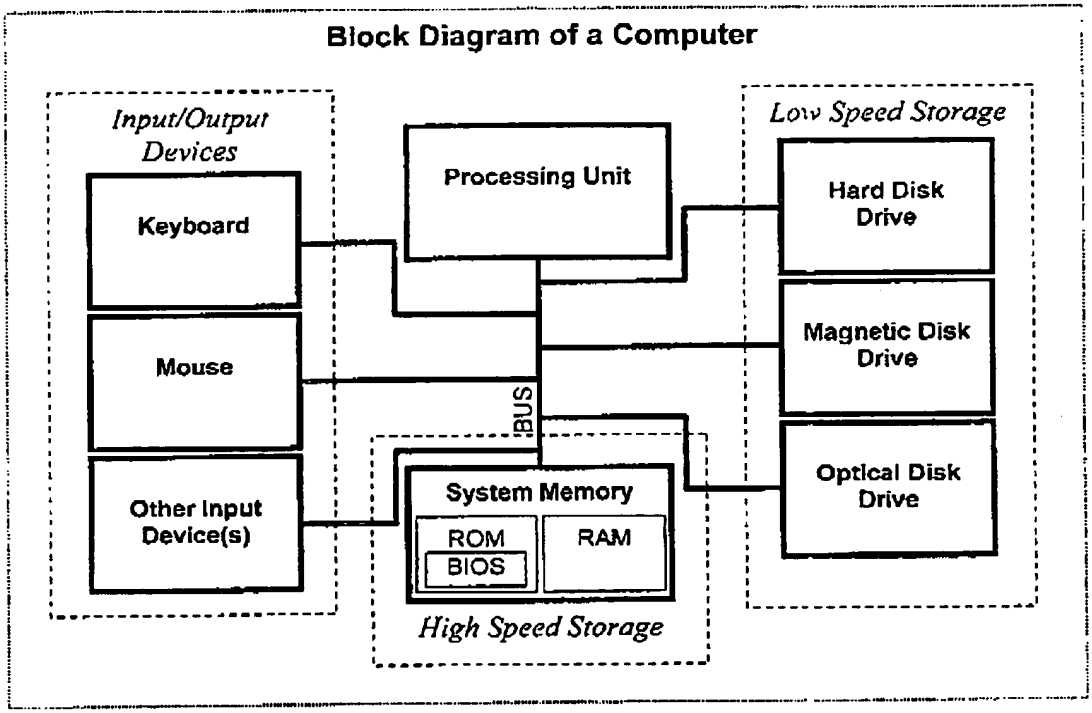
Block Diagram of a Computer
Input/Output Devices
Keyboard
Mouse
Other Input Device(s)
Processing Unit
BUS
System Memory
ROM
BIOS
RAM
High Speed Storage
Low Speed Storage
Hard Disk Drive
Magnetic Disk Drive
Optical Disk Drive

Figure 2

EXHIBIT Y

Parks, Cynthia

From: Parks, Cynthia
Sent: [redacted]
To: Lee Friedman (E-mail); Lee Friedman (E-mail 2)
Subject: "Multimedia Distribution" application

Importance: High

Hello Lee

I was wondering when I might get your feedback on my last draft of the provisional application. I am also faxing you an official patent that Nora prosecuted for Dale. It may shed some light on the format that we are shooting for. Please let me know if you don't receive it this morning.

If the draft still needs a lot of revisions, I'd be happy to give you a call to discuss, or to come by your office at your convenience.

Thanks!

Cynthia Parks
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Tracking:

Recipient	Delivery	Read
Lee Friedman (E-mail)		
Lee Friedman (E-mail 2)	[redacted]	[redacted]
Tocups, Nora		

RECORD OF CONVERSATION

Client/Matter: 36968 / 258392

With: L. Friedman Date and Time: 10:40 am

Telephone ☑ Voice Mail ☐ I called ☐ Called me ☑ returned my call

Personal Conference ☐ Place: [redacted]

Notes:

Mr. Friedman is back in the office. Has been too busy on a mktg project to review the apps, but will start reviewing, and drafting visio drawings now. BC Li Wang is in China, MRF will review my apps first. Maybe go straight to non-prov.

Attorney: _____

KILPATRICK STOCKTON LLP
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Mr. Lee Friedman
Director of Services Architecture
Bellsouth Portal Services
303 Perimeter Center North
Suite 800
Atlanta, GA 30346

Re: Draft of U.S. Provisional Patent Application
Entitled "MULTIMEDIA DISTRIBUTION IN A HETEROGENEOUS NETWORK"
Our Ref: 36968/258392; Your Ref: BS01155

Action Requested by [redacted]

Dear Mr. Friedman:

I have attached the final draft of the provisional application for your review. In reviewing the application, **please consider whether there is anymore detail you can provide** that will allow a more comprehensive description of "how" this invention is to be implemented. Please keep in mind that when this provisional is converted to a utility application, no new matter can be added. Therefore, this application must provide sufficient detail to enable one skilled in the art to reproduce and effectuate your invention. The application must also contain enough detail to secure the broadest protection available *while overcoming the prior art.*

Please contact me if you have any comments or would like any amendments to be made to the application or the associated drawings (also attached). I am happy to provide an electronic version of the application if you so desire.

Unless otherwise instructed, this application will be filed[redacted]

Best regards,

Cynthia R. Parks

Cynthia Parks, Esq.

CP:sjj
Enclosure

cc: Nancy Woodard
Nora M. Tocups, Esq. (w/o encl.)
Dale Malik
Odessa Roberts (w/o encl.)
Karen Stark (w/o encl.)

MULTIMEDIA DISTRIBUTION IN A HETEROGENEOUS NETWORK

FIELD OF THE INVENTION

The present invention relates generally to systems and methods for distributing media and, more particularly, to systems and methods for distributing multimedia content from a single source to multiple users on a heterogeneous network.

BACKGROUND

A heterogeneous network includes segments that are subject to varying distribution parameters, such as bandwidth, protocol, and routing restrictions. Such parameters establish the level of performance of each network segment, commonly referred to as the "quality of service" (QoS). Heterogeneity of a network can create deficiencies in the broadcast quality of information simultaneously transmitted to disparate locations on the network.

One approach to distributing content over a heterogeneous network is to format and to transmit multimedia content separately to each segment according to its QoS parameters. This approach is disadvantageous in that the bandwidth required to achieve simultaneous distribution increases according to the number of segments that have a different QoS. Another approach is to minimize the number of simultaneous transmissions by supporting a limited number of QoS levels, including a best-effort class. This approach is suggested in an article by Salgarelli *et al*, entitled "*Supporting*

IP Multicast Integrated Services in ATM Networks." Proceedings of SPIE Voice&Video '97, Broadband Networking Technologies. Such an approach reduces the additional bandwidth consumed although at the expense of optimizing performance.

There is therefore a need for systems of distributing multimedia content from a single source to multiple users located at various points in a heterogeneous network, while minimizing the bandwidth required at any one point on the network.

SUMMARY

The present invention addresses the needs described above by providing systems and methods of distributing multimedia content over a heterogeneous network. The systems and methods of the present invention optimize the distribution of multimedia content from a single source to multiple destinations along a heterogeneous network by transmitting multimedia content reliably and consistently, regardless of the distribution parameters of various segments of the network (e.g., unicast, or multicast).

According to an exemplary embodiment of the invention, a system transmits multimedia content from a single source according to the distribution parameters of each network segment, thereby yielding an advantageous reduction of the bandwidth consumed at the source upon transmission of the multimedia content. Briefly described, the systems and methods optimize the distribution of multimedia content

based upon the quality of service (QoS) parameters of targeted segments of a network at a given time. If segment parameters change, the central servers reprogram the dispersed media servers to adapt to accommodate the new network parameters.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate preferred embodiments of the present invention and, together with the description, disclose the principles of the invention. In the drawings:

Figure 1 is a diagram of a network according to one embodiment of the invention; and

Figure 2 is a block diagram of a user device according to one aspect of the invention.

DETAILED DESCRIPTION

I. Overview

In an exemplary communications network 20 according to the invention, a central set of servers 10 provide a source of multimedia content. The central servers 10 are connected to a communications network that includes multiple segments, any of which can branch off of a backbone of the communications network. Media servers 15 are dispersed throughout the network such that one media server 15 is positioned at the head of each network segment, i.e., near the point at which the

network segment branches off from the backbone. Each media server 15 is programmed by the central servers to distribute multimedia content according to the distribution parameters of its adjacent segment or segments.

II. Exemplary Environment

In an exemplary embodiment of the present invention, the communications network 20 is any type of system that transmits any combination of voice, video and/or data between targeted stations. The communications network 20 includes the transmission media (e.g., cables) and all supporting hardware (e.g., bridges, routers and switches), and can include antennas and towers. The network 20 can be comprised of a combination or combinations of network types (e.g., peer-to-peer or client/server), scales (e.g., local area network (LAN) or wide area network (WAN)), and physical and logical network constructions (topologies). Known network topologies include broadcast (network bus, or backbone), point-to-point electrical and optical repeater links (network ring), logical star, and hybrid combinations thereof. In an exemplary embodiment, the network 20 is composed of multiple sub-networks, and therefore has a hybrid topology.

III. Centralized Source Servers

Referring to Fig. 1, a set of centralized servers 10 are positioned at the source of the distribution of media content, hereinafter referred to as "source servers." Each

source server 10 can be a computer or other device that manages network resources and processes requests for media content.

As illustrated in Fig. 2, an exemplary source server 10 for implementing the inventions comprises a computer 10 including a processing unit 30, high speed storage 36 having system memory 36a, and a system bus 38 that couples the system memory 36 to the processing unit 30. The system memory 36 includes read only memory (ROM) 36c and random access memory (RAM) 36b. A basic input/output system (BIOS) 36d, containing the basic routines that help to transfer information between elements within the computer 10, such as during start-up, is stored in ROM 36c. The computer 10 further includes low speed storage 34, such as a hard disk drive 34a, a magnetic disk drive 34b, e.g., to read from or write to a removable disk, and an optical disk drive 34c, e.g., for reading a CD-ROM disk or to read from or write to other optical media. The hard disk drive 34a, magnetic disk drive 34b, and optical disk drive 34c include a hard disk drive interface, a magnetic disk drive interface, and an optical drive interface, respectively, for coupling the drives to the system bus 38. The drives 34 and their associated computer-readable media provide nonvolatile storage for the computer. Although the description of computer-readable medium above refers to a hard disk, a removable magnetic disk and a CD-ROM disk, other types or media readable by a computer, such as magnetic cassettes, flash memory cards, digital video disks, Bernoulli cartridges, and the like, can also be used.

A number of program modules can be stored in the drives and RAM, including an operating system, one or more application programs, a shared code library, and a property browser program module. A user may enter commands and information into the personal computer through a keyboard 32a and pointing device 32b, such as a mouse. Other input/output devices 32c can include a microphone, joystick, satellite dish, scanner, or the like. These and other input/output 32c devices are often connected to the processing unit through a serial port interface coupled to the system bus, but can be connected by other interfaces, such as a universal serial bus (USB). The input/output devices 32c include a monitor or other type of display device connected to the system bus 38 via an interface, such as a video adapter. In addition to the monitor, computers 10 typically include other peripheral output devices 32c, such as speakers or printers.

The source server 10 operates in a networked environment using logical connections to one or more media servers 15. Media servers 15 typically include many or all of the elements described in the source server 10. Each media server 15 is connected to one or more recipient computers 5.

The recipient computers 5 can be any type of device, including but not limited to digital televisions, enhanced televisions, WebTV, any other type of interactive television, desk-top computers, lap-top computers, Palm Pilot, PocketPC, Visor, any other type of Personal Digital Assistants, Internet appliances, data devices, mobile radiotelephones, interactive pagers, any other type of communication device, hand-

held units, multiprocessors systems, microprocessor systems, minicomputers, mainframe computers, and the like. Each recipient computer 5 can include a memory storage device, which can include stored program modules that are executable by the media server 15. The logical connections include a local area network (LAN) and a wide area network (WAN).

When used in a LAN networking environment, the recipient computer 5 is connected to the LAN through a network interface. When used in a WAN networking environment, the recipient computer 5 typically includes a modem or other means for establishing communications over the WAN, such as the Internet. The modem, which can be internal or external, is connected to the system bus via the serial port interface. In a networked environment, program modules depicted relative to the personal computer, or portions thereof, can be stored in the remote memory storage device. The network connections are exemplary and other means of establishing a communications link between the recipient computer and the network can be used.

In the exemplary embodiment, each source server 10 includes a console or other user interface that enables an administrator to specify the parameters of each segment of the network. The segment parameter data stored in the centralized source servers are used to program the appropriate dispersed media servers 15.

IV. Network Segments

In the exemplary embodiment, the communications network 20 includes multiple segments. The segments can differ possibly due to disparate network technologies, and thus is subject to different parameters, such as bandwidth restrictions, communications protocols, and routing restrictions. Bandwidth, commonly expressed in bits per second (bps), represents the transmission capacity of a communications network. For example, the bandwidth of an unswitched private T1 segment is 1.6Mbps, while the bandwidth of an OC48 ATM segment can exceed 2488Mbps.

Each network segment can be governed by varying rules governing the transmitting and receiving of data, commonly referred to as protocols. Examples of protocols include Internet Control Message Protocol (ICMP), User Datagram Protocol (UDP), Transmission Control Protocol (TCP), and Internet Group Management Protocol (IGMP). For example, some communications networks have the capability of sending "one-to-many" transmissions of content to multiple intended recipients (multicast), while others can only "unicast" which requires an individual transmission for each intended recipient.

Each network segment can also be subject to different routing parameters. Routers typically use mathematical formulae, known as routing protocols, to determine which of several available paths is the most expedient path along which to forward a stream of transmitted data packets to a final destination. The routers can

consider network characteristics such as traffic, speed, and economics to optimize the data path. Commonly, route servers process this information, which is then passed on to the routers, thereby allowing the routers to focus only on forwarding the stream of data packets accordingly. Routers also replicate transmissions as required depending upon whether the transmissions will be forwarded onto unicast or multicast segments.

In a preferred embodiment, to achieve distribution of multimedia content while maintaining a consistent quality of service (QoS), an architecture of centralized source servers 10 coupled with dispersed media servers 15 adapts the distributed media content to the varying parameters of the intended network segments.

V. Dispersed Media Server Architecture

As illustrated in Figure 1, the network 20 includes media servers 15 that are dispersed throughout the communications network 20, optimally being positioned at the head of each network segment. Each media server 15 is programmed by a source server 10 to adapt multimedia content according to the parameters of each intended segment that is downstream from the media server 10.

When a source server 10 receives a request for multimedia content to be distributed, it transmits the multimedia content to all intended media servers 15. Each media server 15 then transmits the multimedia content to intended recipients 5 that are downstream from that media server 15, while first adapting the multimedia content according to the parameters of the intended segment or segments.

As an example, a separate stream of data packets typically must be created, addressed, and forwarded for each destination on a unicast segment of the network. Thus, at the source of the broadcast, copies must be made of the stream of data packets before transmission. If synchronized reception is intended, the source must transmit the copies of the stream of data packets simultaneously, thereby increasing bandwidth consumed several fold.

In contrast, for each multicast network segment to which it is interconnected and to which transmission is intended, a router addresses and forwards a copy of the stream of data packets. Therefore, only one stream of data packets must be transmitted from the source 10 to the network 20. When the stream of data packets reaches a router, the router forwards copies to multicast network segments as appropriate, and the original stream of data packets continues to the next router or destination. Disadvantageously, a source that intends synchronized reception by destinations located on both unicast and multicast segments of a heterogeneous network must simultaneously transmit the single stream of data packets for the multicast segments along with a copy for each unicast destination. In an exemplary embodiment of the present invention, media servers are programmed to receive a single transmission of a stream of data packets, and to forward the stream of data packets to the intended segments of the network according to parameters of each intended segment. When the transmission reaches routers positioned downstream

from the media server 15 the routers replicate the multimedia stream as needed, and forward the multimedia stream to its intended recipients 5.

The foregoing description of the preferred embodiments of the invention has been presented only for the purpose of illustration and description and is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many modifications and variations are possible in light of the above teaching.

The embodiments were chosen and described in order to explain the principles of the invention and their practical application so as to enable others skilled in the art to utilize the invention and various embodiments and with various modifications as are suited to the particular use contemplated.

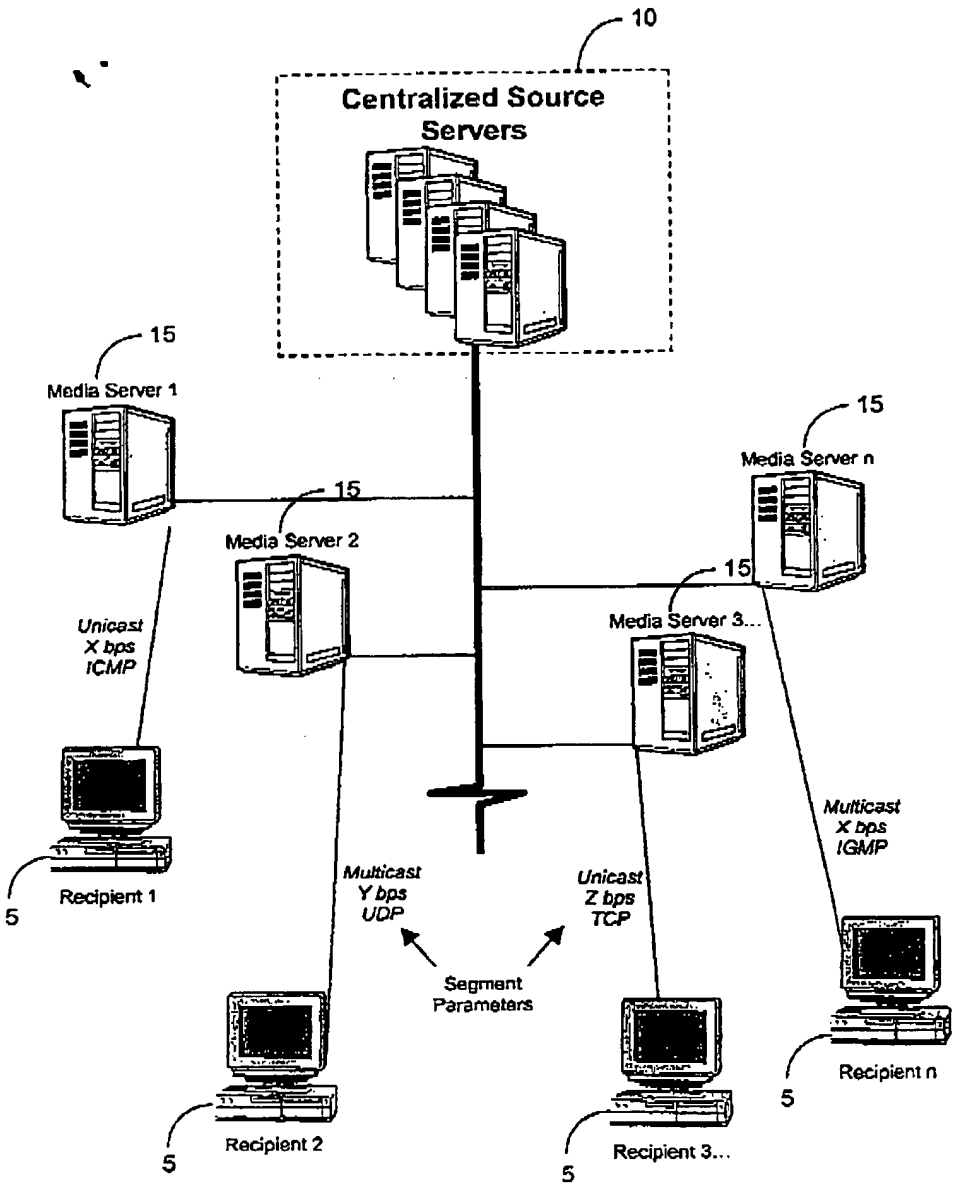
10
Centralized Source Servers
15
Media Server 1
15
Media Server 2
15
Media Server n
15
Media Server 3...
Unicast X bps ICMP
Multicast Y bps UDP
Unicast Z bps TCP
Multicast X bps IGMP
Segment Parameters
Recipient 1
Recipient 2
Recipient 3...
Recipient n
5
5
5
5

FIGURE 1

16

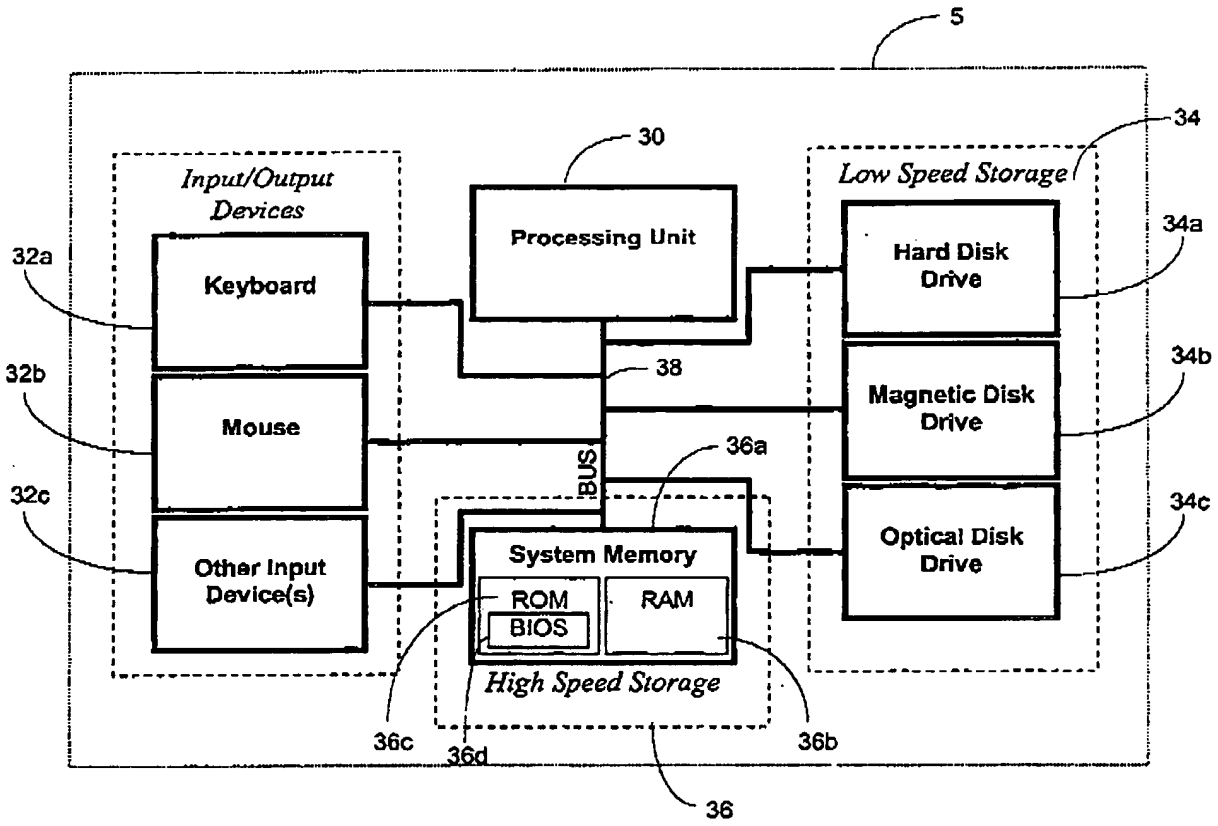

FIGURE 2